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Original Article

Efficacy of sleep position modification to treat positional obstructive sleep apnea

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ABSTRACT

Objective/Background: To assess the feasibility and efficacy of sleep position modification in preventing supine sleep and improving sleep-disordered breathing and relevant clinical outcomes in positional Obstructive Sleep Apnea (OSA) patients.

Patients/Methods: Eighty-six consecutive participants with moderate positional OSA on routine diagnostic polysomnography underwent a randomized controlled parallel group design trial of 4-weeks treatment using a sleep position modification device (active) or sleep hygiene advice (control). Outcomes were measured at baseline and following a 4-week treatment period.

Results: There was a significant reduction in the amount of supine sleep in the active group (mean ± SD change from baseline, active group 99.5 ± 85.2 minutes, control group 68.6 ± 103.2 minutes, $p = 0.002$), and an improvement in apnea-hypopnea index (AHI) (active group reduced by 9.9 ± 11.6, control group reduced by 5.3 ± 13.9, $p = 0.013$). Post-hoc analyses indicated that positional therapy was most effective for patients with baseline AHI cut-off above 20 ($p = 0.02$). Logistic regression showed that a treatment response (AHI < 10) was more likely in the active group (OR = 5.57), and those with higher baseline nadir oxygen desaturation (OR = 1.95) and non-supine AHI (OR = 0.55). There were no significant improvements in quality of life, daytime sleepiness, mood, symptoms, neuropsychological measures or blood pressure in the active group.

Conclusions: The position device utilized in this study was effective in reducing supine sleep and AHI, which was significant in those with baseline AHI ≥20. Longer duration studies of physical treatments that modify sleep position are needed to explore further whether additional clinical benefits in are achievable.

1. Introduction

Obstructive sleep apnea (OSA) is a common disease, estimated to affect 4% of men and 2% of women in the 30–60 year old age group [1]. The two main treatments for OSA (continuous positive airways pressure, (CPAP) and mandibular advancement devices) are effective, but adherence and cost remain an issue for many patients. In particular, patients from lower socioeconomic backgrounds are less receptive to CPAP treatment for their OSA [2]. There is a clear need for well-tolerated, inexpensive, and simple treatments, particularly for those with less severe disease.

Positional OSA is reported to be present in 50%–60% of all patients with OSA [3], arbitrarily defined as a supine apnea-hypopnea index (AHI) at least twice that of the non-supine AHI [3,4]. A number of mechanisms have been proposed to explain this observation. These include a posture-dependant structural change in the upper airway, elevation of the diaphragm in the supine position, and consequent increased upper airway collapsibility or reduction in upper airway muscle activity with the change from lateral to supine sleep position [3,4]. Several studies in anaesthetized normal human participants have shown an increase in upper airway calibre in the lateral recumbent position compared to supine [5–7], suggesting that passive anatomic changes are involved. A recent study of awake OSA and healthy participants has shown a change in shape but not size of the velopharyngeal and oropharyngeal airway from the supine recumbent to lateral position during wakefulness, and smaller

Abbreviations: AHI, Apnea Hypopnea Index; BMI, Body Mass Index; CPAP, Continuous Positive Airways Pressure; ESS, Epworth Sleepiness Scale; FOSQ, Functional Outcomes of Sleep Questionnaire; nonREM, non Rapid Eye Movement; OSA, Obstructive Sleep Apnea; PSG, Polysomnography; REM, Rapid Eye Movement; SASQ, Symptoms of Sleep Apnea Questionnaire; SD, Standard Deviation; TST, Total Sleep Time.

This work was performed at the Institute for Breathing and Sleep, Austin Health, Melbourne, Victoria, Australia.

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velopharyngeal cross-sectional area of OSA compared to control participants in the supine but not lateral recumbent positions [8]. During sleep, upper airway closing pressure did not differ in the supine compared to the lateral position, but opening pressure was significantly reduced in the lateral position [9].

Patients with positional OSA are likely to be younger, less obese, have less severe OSA and less objective daytime sleepiness on Multiple Sleep Latency Test compared to those with non-positional OSA [3,4]. Given the issues with adherence with CPAP treatment, particularly in this population of patients, alternative treatments for avoiding supine sleep have been developed and tested in research studies. One of the most widely reported methods in the literature on positional therapy [10], the so-called tennis ball technique, involves attaching on of more pockets to the back of a shirt that is worn during sleep. Tennis balls are then placed in the pockets along the spine, thus preventing the patient from sleeping in the supine position. Several studies have investigated the therapeutic benefits of avoiding supine sleep using the tennis ball technique and other devices that prevent supine sleep, as well as alarm systems that awaken patients when they are in supine sleep [11–17]. The benefits shown for sleep disordered breathing are inconsistent across studies and the impact on daytime function has not been adequately investigated. Only a few randomized controlled trials comparing positional devices with CPAP have been conducted over the last 20 years [18]. Two of these studies were relatively small ($N < 20$), and found that the improvements in AHI and sleep hypoxemia after positional therapy (soft ball back pack and a thoracic anti-supine band) were significantly less than the CPAP benefit [19,20]. No significant difference in neurobehavioral outcomes or sleepiness was observed, possibly due to insufficient sample size. More recently, newer therapies have been developed including a novel body position orienting device (BuzzPOD, Gorman ProMed Pty Ltd) and a neck-worn vibrating device, both of which reduced supine sleep and have demonstrated a statistically significant improvement in AHI, however no measures of daytime function were recorded [21,22].

Positional therapy appears to be a promising treatment option for a large number of OSA patients, however many studies have been conducted on a comparatively small number of participants and there is an urgent need for further controlled studies to examine its efficacy. The current study aimed to determine whether sleep position modification is efficacious in preventing supine sleep, and evaluate improvements in sleep disordered breathing and clinical outcomes using a large randomised controlled study.

2. Methods

A randomized, conservative treatment controlled, parallel group trial over four weeks was carried out to assess the efficacy of a sleep position modification device in treating patients with positional OSA. The study was carried out in the Institute for Breathing and Sleep at Austin Health, Melbourne, Australia. This study was approved by the Austin Health Human Research Ethics Committee, and informed written consent was obtained from all participants.

2.1. Participants

One hundred and sixteen eligible OSA patients from Austin Health were approached following diagnostic PSG, of whom 86 agreed to participate (Fig. 1). The reason given for non-participation in all cases was the time commitment involved. Inclusion criteria were: at least 18 years of age, supine OSA (supine AHI at least twice the non-supine AHI) on overnight diagnostic PSG, total AHI ≥ 10, and at least four hours of sleep with at least 30 minutes sleep in both the lateral and supine recumbent positions and 30 minutes of REM sleep. Patients with minimum blood oxygen saturation less than 75% in REM or 80% in non-REM were excluded, as were patients with clinically significant co-existing disease (eg, diabetes, unstable ischemic heart disease) or sleepiness deemed to be unsafe and requiring urgent treatment (eg, history of falling asleep while driving or working, or an Epworth Sleepiness Scale or ESS) [23] score greater than 16. Participants were also excluded if they had any musculoskeletal condition that precluded moderate exercise (as this was part of the sleep hygiene instructions) or lying on their side while asleep. To ensure valid interpretation of the neurobehavioral tests,

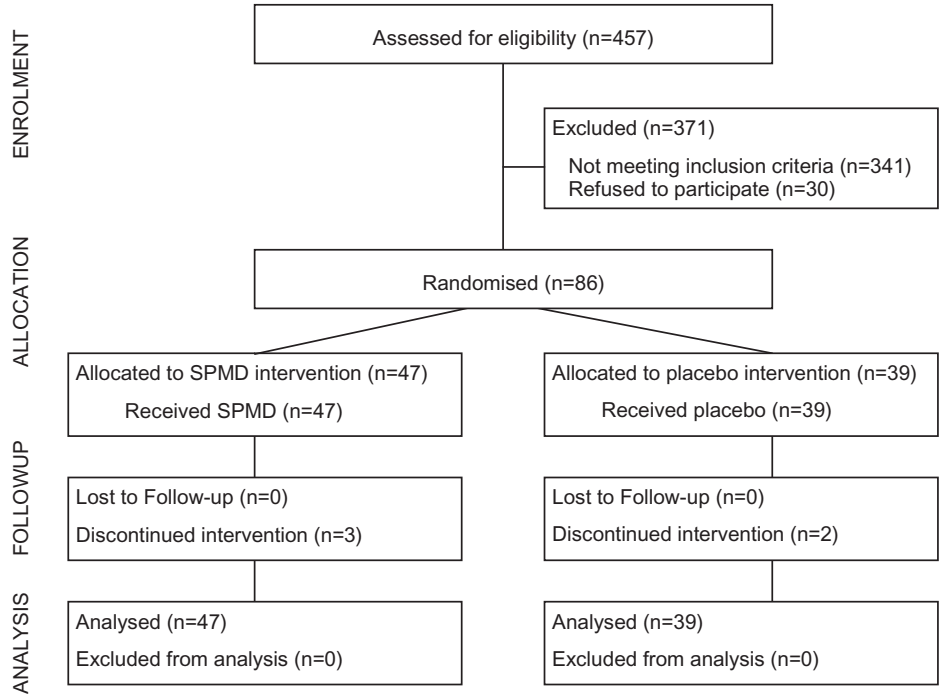

Fig. 1. Consort diagram of study flow.